DOCUMENT RESUME

ED 209 107 SE 035 863

AUTHOR Lukco, Bernard J.
TITLE Energy Conservation Management for School Administrators: An Overview.
INSTITUTION ERIC Clearinghouse for Science, Mathematics, and Environmental Education, Columbus, Ohio.; Ohio State Univ., Columbus, Ohio. Information Reference Center for Science, Mathematics, and Environmental Education.
PUB DATE Aug 81
NOTE 44p.
AVAILABLE FROM Information Reference Center (ERIC/IRC), The Ohio State Univ., 1200 Chambers Rd., 3rd Floor, Columbus, OH 43212 ($2.00).

EDRS PRICE MF01/PC02 Plus Postage.
DESCRIPTORS Cost Effectiveness; *Educational Facilities Design; *Educational Facilities Improvement; *Energy Conservation; *School Administration; School Buildings; School Maintenance; *Student Transportation
IDENTIFIERS Energy Audits; *Energy Management

ABSTRACT

Information concerning energy conservation management is presented to aid school administrators in improving the energy efficiency of their buildings and programs. Three general topics are discussed: (1) the general nature and unique characteristics of school energy management; (2) initial steps in developing a conservation program, including formulation of a task force and the conduct of an energy audit; and (3) specific energy saving techniques related to retrofit and operational changes, construction of new facilities, and transportation. Appendix A provides bibliographic references to materials which may be helpful to administrators in initiating or improving school energy conservation programs. All items listed are available through the Education Resources Information Center (ERIC). Appendix B lists governmental agencies and private organizations which provide energy information and assistance. (DC)

****
* Reproductions supplied by EDRS are the best that can be made *
* from the original document. *
****

ED209107

U.S. DEPARTMENT OF EDUCATION
NATIONAL INSTITUTE OF EDUCATION
EDUCATIONAL RESOURCES INFORMATION
CENTER (ERIC)

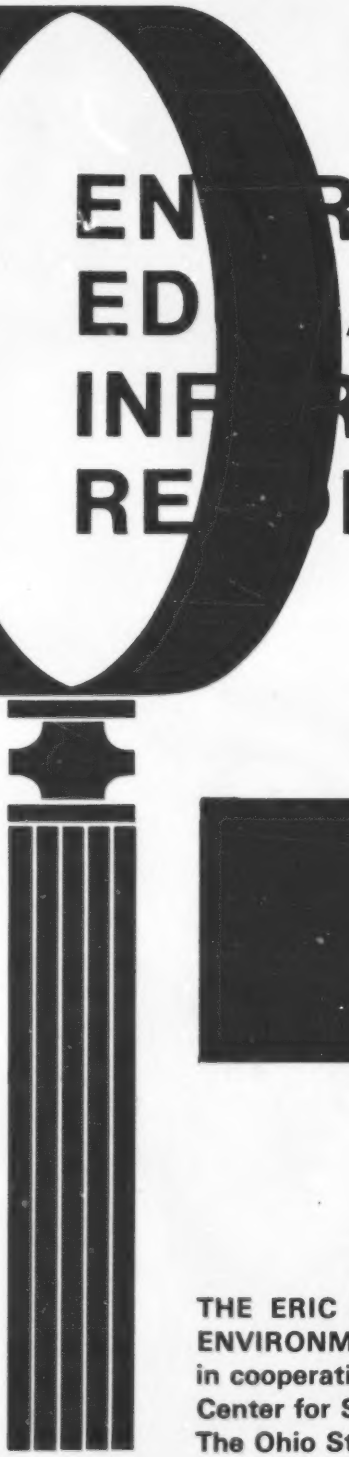
X This document has been reproduced as received from the person or organization originating it.

☐ Minor changes have been made to improve reproduction quality.

• Points of view or opinions stated in this document do not necessarily represent official NIE position or policy.

ENVI
EDU
INFO
REPO

EN RONMENTAL
ED ATION
INF RMATION
RE RT



THE ERIC SCIENCE, MATHEMATICS AND ENVIRONMENTAL EDUCATION CLEARINGHOUSE
in cooperation with
Center for Science and Mathematics Education
The Ohio State University

SE 035 863

BY
BERNARD J. LUKCO

ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS: AN OVERVIEW

SMEAC INFORMATION REFERENCE CENTER
THE OHIO STATE UNIVERSITY
COLLEGE OF EDUCATION AND
SCHOOL OF NATURAL RESOURCES
1200 CHAMBERS ROAD - 3RD FLOOR
COLUMBUS, OHIO 43212

AUGUST, 1981

Publication sponsored by the SMEAC Information Reference Center, in cooperation with the College of Education and the School of Natural Resources of The Ohio State University, and the ERIC Clearinghouse for Science, Mathematics, and Environmental Education. Points of view or opinions expressed in this report do not necessarily represent those of any of the sponsoring or cooperating entities.

TABLE OF CONTENTS

Preface v

School Energy Management. 3

Planning for Conservation 4

Audits. 5

Retrofit and Operational Changes. 7

Construction of New Facilities. 12

Transportation. 16

Appendix A: Resources for Energy Conservation Management for School Administrators. 23

Appendix B: Governmental and Private Sources of Assistance on Energy Management 37

PREFACE

The purpose of this monograph is to make school administrators aware of information and available resources which will help to improve the energy efficiency of school operations. Because of the complexity of energy problems, no single approach to the proper management of daily energy operations is provided; rather, a broad range of recommendations is made, not all of which will be found appropriate for every situation.

The benefits of energy conservation are already evident in the experiences of many school systems. Educational institutions and school districts have successfully made cost-beneficial improvements in the use of fuels and energy consumption. Planned conservation programs have resulted in more energy-efficient buildings; staff members have been trained in energy retrofit procedures; transportation systems have been altered to save fuel; and school officials have made appropriate use of technical assistance. Many examples of such improvements have been documented.

The assumption upon which this monograph is based is that review of available information can be helpful in organizing an effective energy conservation program or improving an ongoing effort. In addition to the information reviewed in the body of the monograph, Appendix A contains summaries of specific documents obtained from a search of the ERIC catalogs Resources in Education (RIE) and Current Index to Journals in Education (CIJE). Details of their availability are included.

Besides consulting written materials such as this publication, school officials should contact state, federal, and private organizations to obtain additional information and assistance. Appendix B lists government agencies and private organizations which can provide such assistance. Frequently, periodic newsletters or journals, as well as grants and consultant assistance, are available. For example, the federal government, through the Department of Energy, will provide 50/50 matching funds to schools for energy audits and modification of buildings.

Assistance in developing this monograph was received from Dr. Philip K. Piele, Director, and staff of the ERIC Clearinghouse of Educational Management, University of Oregon, who reviewed the manuscript and made recommendations for inclusion in Appendix A.

ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS: AN OVERVIEW

SCHOOL ENERGY MANAGEMENT

It has been estimated that on any given school day approximately 25 percent of the nation's population is located within educational institutions. Energy to support instructional activities for this large number of people is used in a variety of forms, including light, heat, ventilation, equipment operation, and transportation.

As the cost of energy increases and supplies become more limited, school administrators are seriously considering methods to control and manage consumption. Abundant success stories suggest that there are savings available to schools when systematic approaches are applied to the problem. Quick action measures that can be readily accomplished by existing staff should result in immediate reductions of fuel and energy. More complex modifications that may take several years to accomplish can result in greater savings.

As administrators search for ways to reduce energy consumption, they often find that many buildings consume large quantities of energy by virtue of their design. Although major alterations are difficult and costly, low-cost alternatives are possible for the short term, permitting time to plan long-range energy conserving methods. An efficiently managed building can save as much as 30 percent in energy.

The management of schools is unique. Unlike other large commercial users of fuel, they cannot easily pass on increased costs to the consumer. Budgets are often locked into certain spending patterns. In a typical school budget at least 85 percent is allocated to personnel costs (salaries, benefits, etc.) and the remaining 15 percent (called discretionary) to books, athletics, special programs, and utility bills.

Another characteristic of school systems is their vast differences in size, equipment, personnel, and student population. A large urban school is faced with energy costs unlike those of a rural school. Therefore, a specific comprehensive energy management program should be developed for each school entity.

There is little doubt that for the foreseeable future schools will be confronted with increasing energy costs, possible shortages and tightened budgets. Programs for effective energy management must be implemented if current academic environments are to be maintained and school closings caused by energy concerns avoided.

Austerity is causing many school officials to consider recycling and preserving old buildings rather than constructing new facilities. For districts with expanding student populations, however, new construction is unavoidable. Those who are planning new facilities must examine the total needs of the district. Construction of additional space and purchase of new equipment must be done in ways that will permit as much curricular flexibility as possible and still be economically and educationally sound.

New methods and devices to conserve energy are being developed, but they may involve high initial costs and retraining of staff to operate them efficiently. The decision as to what methods to adopt depends on multiple considerations. The construction and operation of buildings should strike a balance between short-term and long-term spending of public funds. Attaining such a balance may require a critical examination of current policies, attitudes about energy, and alternative construction options.

Although the cost of energy is of primary concern to administrators, school districts also have an ethical obligation to play a leadership role in educating the community to be conservation-minded. By example, schools can show that they are concerned with conserving the natural resources of the nation for use by the future generations they are educating. Public support will be greater if a leadership role is exhibited.

PLANNING FOR CONSERVATION

A helpful way to begin the planning of a sound program of energy conservation is the appointment of a task force of people who will be directly affected by the results of the program. An energy task force committee can be used to facilitate participation, initiate activities, and monitor results. A task force also encourages coordination and enhances communication among members, resulting in less duplication and a more comprehensive program. The program's success will depend on the support it receives from the community, faculty, staff, and students, all of whom should be represented on the task force. A more extensive list of groups from which task force members should be selected is as follows:

(1) Members of the board of education

(2) PTA

(3) Faculty members

(4) School administrators

(5) Operations and maintenance personnel

(6) Students

(7) Transportation personnel

(8) Food service personnel

(9) Qualified lay persons

Frequent scheduled meetings of the task force are essential during the beginning phases of operation. Specific actions will be required that may significantly change the way the school functions. Continued dialog during all phases is important but is most critical during the initial phase when an action plan should be developed to

(1) determine goals, objectives, and strategies for each building;

(2) conduct a survey and energy audit for each building;

(3) assign responsibilities to specific individuals and groups;

(4) explore the possibility of using outside consultants; and

(5) recommend specific actions that will result in more efficient energy use.

As the energy conservation plan becomes organized, consideration should be given to the appointment of an Energy Conservation Manager. A large school district, or one with complicated energy problems, should consider hiring qualified individuals to assist with committee responsibilities, employ consultants, coordinate work activities with school personnel, and guide the implementation of the energy conservation program, A smaller system should consider the assignment of a staff member familiar with school operations and provide adequate time for that person to organize an effective program.

AUDITS

One of the most important aspects of an energy management plan is the conduct of a survey and audit. The survey should list all uses of energy and describe the building characteristics. The audit should attempt to determine the amount of energy being used, for what purposes, and whether it is being used effectively. Since most school

buildings were designed during a period of abundant and inexpensive energy, initial costs for construction were given more weight in the decision-making process than other factors. A review of current energy consumption can be revealing and provide data required to correct some of the major energy consumption factors.

The energy audit should be initiated by collecting accounting records on annual consumption of all types of energy for each building. With the survey information and energy sources identified, a team of specialists can inspect and evaluate specific facilities. Initial inspection to observe and analyze the building structure, operational practices, and other factors is essential. This procedure familiarizes the inspection team with the types of equipment and operations of the facility.

The level of skill required of the inspection team will depend on the type of building to be audited. Older buildings without climate control systems do not require a sophisticated analysis. Buildings with mechanical ventilation and air conditioning should be audited by individuals with substantial background in these systems.

Some school districts may prefer to hire outside consultants, whereas others may depend on their internal resources to conduct the actual audit. An outside consultant may actually save money. Generally, outside consultants can recognize inadequacies in the building and can identify the lack of technical skills of staff members operating the systems. Professional engineering firms charge a fee for their services. Costs can be held to a minimum if important information is collected in advance and made available to the engineer. Some utility companies, on request, will assign one of their staff members to the audit team without charge. If the school can convince a qualified local citizen to volunteer his or her time to help conduct an audit, the system will benefit from both the expertise and the community concern of the individual.

The result of the audit should be a set of recommendations for action by the school district. These recommendations are generally at two levels; i.e.,

(1) actions that have little or no cost and can be accomplished with the technical skills available to the school district, and

(2) actions that can be achieved through capital investment in modifying building hardware, which will be recovered during the lifetime of the building.

An audit service developed by Educational Facilities Laboratories with federal support is available nationally. The Public Schools Energy Conservation Service (PSECS) is a computer-based auditing service. Information is collected on the type of school, based on date of completion, plan types, construction, mechanical systems and use of glass. Data detailing uses of the school during the day, after school, evenings, and weekends are collected. Finally, energy consumption based on utility bills or actual measurement of fuel is entered.

The PSECS printout of an individual school compares its actual energy use with what it should be using if it were operating according to guidelines. Also provided are suggestions for reducing energy consumption in the school and estimates of the savings that would result if the suggestions were followed. Since the service does not provide on-site analysis, all conclusions require further study. Additional information on this service can be obtained from Public School Energy Conservation Service (PSECS), 1572 South 1400 East, Salt Lake City, Utah 84105; (801) 484-7260. The cost for an elementary school audit is $75; secondary school audits cost $100.

RETROFIT AND OPERATIONAL CHANGES

Provision of a safe and healthful environment conducive to learning is as important to school districts as saving energy costs. Adequate light for safety and good vision, sensible temperature, and ventilation must be provided to students and staff. Educational tasks should be performed in an environment that is physically healthy and psychologically comfortable.

Over the past years, devices and systems used to modify and control the internal environment have tended to be mechanical and electrical, requiring extensive energy for their operation. These systems require considerably more fuel than methods of control that use natural sources (such as sunlight). The need to make the systems more efficient by improving their operation and maximizing the use of natural sources is basic to the retrofit process.

In most instances, custodial, maintenance, and building engineers, and school district specialists, will be directly involved in this process. It should not be assumed that such personnel have the skills necessary to make all modifications. However, they can make major contributions by improving operational and maintenance (O & M) procedures, learning new skills, and improving energy efficiency by making structural, mechanical, and electrical modifications within their capabilities.

School districts need skilled personnel trained to operate and maintain equipment if an energy conservation program is to be fully effective. An O & M training program to upgrade the knowledge and skills of school building personnel concerning architectural, mechanical, and electrical components can be highly beneficial. The increased proficiency and expertise of these individuals realistically can be expected to result in a cost-beneficial savings. In addition, O & M personnel can gain knowledge and improve their technical skills by attending courses at community colleges and technical institutes.

Skill improvement also can be obtained from manufacturer-sponsored courses on specific pieces of equipment or systems. A request made to a manufacturer's representative can often result in assistance and training. The most popular option is on-the-job instruction. A trainer, employed or hired by the school district, uses the actual building and equipment for instructional purposes. Familiarization with specific types of equipment and procedures will result in increased efficiency of operations that can be immediately observed. On-the-job instruction gives trainees only information that is important for their functions.

Inadequate maintenance, conducted in a sporadic, unorganized manner, results in excessive energy consumption. Proper maintenance saves energy and prolongs the lifetime of equipment. A review of current O & M procedures should be conducted and an improved schedule developed and monitored.

Preventive maintenance will also save energy. Particular attention should be given to systems that are most likely to cause excessive energy consumption through maladjustments or lack of maintenance. These include ventilation systems, boilers and their combustion systems, and automatic temperature control systems.

Generally, buildings that are the least efficient should be given priority over those where energy loss is minimal. Similarly, projects that are of low cost and can be accomplished by in-house personnel should receive priority over those that are costly and require outside specialists. Operational changes that minimize disruption of school activities are scheduled first, while those activities that create noise or other disturbances are best scheduled when classes are not in session.

Sample lists of modifications that can be considered by school districts are presented for review; they are not comprehensive and cannot replace an energy audit. Rather, they are intended to give an overview of suggested activities that can be accomplished with technical skills available to the school district.

Heating, ventilation, and air conditioning

1. Insulate hot bare pipes
2. Install caulking and weather stripping
3. Preheat combustion air
4. Replace worn boiler controls
5. Insulate steam lines
6. Install and/or replace steam traps
7. Return steam condensate to boiler
8. Reduce air volume
9. Install automatic thermostats
10. Install heat recovery equipment
11. Install time clocks for air conditioners
12. Install temperature controller and sensor
13. Establish a ventilation operation schedule so exhaust system operates only when needed
14. Reduce use of heating and cooling systems in spaces used infrequently
15. Turn off heat and cooling during the last hours of occupancy
16. Consider closing outside air dampers during the first and last hours of occupancy
17. During the cooling season, flush the building with cooler outdoor air during evening and night hours
18. Turn off all noncritical exhaust fans
19. Keep refrigeration coils free of frost buildup

Lighting

1. Remove lamps or fixtures not needed
2. Replace incandescent lighting with energy-conserving fluorescent lamps
3. Design lighting for specific tasks

4. Lower height of lighting fixtures

5. Control exterior lighting

6. Disconnect ballasts from fluorescent fixtures if lamps are removed

7. Schedule lighting maintenance and relamping programs to maintain good lamp efficiency

8. Use natural light when available in a building

9. Use photocell and/or astronomical time clock controls for outdoor lighting whenever feasible

Operational

1. Schedule student and staff hours to maximize daylight working hours

2. Consolidate activities into fewer rooms

3. Install signs on exterior walls near doors providing instructions to keep doors closed

4. Post signs near electric power-consuming machinery urging it be used sparingly

5. Establish a policy to review efficiency when purchasing energy-consuming devices

6. Repaint or clean exterior finish to improve reflective characteristics; when repainting, use light surfaces to reflect both heat and light

7. Where open space is available, plant trees or large shrubs to act as windbreaks and to reduce solar penetration

8. Install adjustable outdoor shading devices such as sunshades, which reflect solar heat before it enters the building; such sunshades also enable entrance of warming rays during the heating season

9. Reglaze windows with double or triple glazing or with heat absorbing and/or reflective glazing materials

10. Add reflective materials to the window side of draperies to reflect solar heat when draperies are drawn

11. Use opaque or translucent insulating materials to block off and thermally seal all unused windows

12. Install storm windows and doors where practical

13. Repaint or resurface the roof to make it more reflective

14. Add or improve roof and wall insulation

15. Develop detailed shutdown program for maximizing energy savings during holidays and semester breaks, and an abbreviated program for weekends

Water

1. Install decentralized water heating

2. Install efficient nozzles and faucets

3. Adjust valves for minimum water use

4. Reduce domestic water temperatures to 120° F

5. Install flow-limiting shower heads

6. Plan maintenance to prevent faucet drips

7. Increase the amount of insulation on hot water pipes and storage tanks

8. Install a pressure-reducing valve on the main hot water service to restrict the amount of flow

9. Provide hand flush valves for urinal flushing rather than continuous water flow systems

An operational change that requires careful consideration is changing school calendars to take advantage of days least likely to impact fuel and energy resources. A computer simulation of a typical Colorado school suggests that:

(1) Shutting down the school completely during Christmas vacation and the month of January could result in an annual heating fuel saving of 23.9 percent.

(2) Extending Christmas vacation another week could result in heating fuel savings of 5.8 percent per year.

(3) Starting school as late as 11:00 a.m. in the winter and running later in the afternoon would save only about 5 percent of the heating fuel per year.

(4) Using the school on a year-round basis, requiring air conditioning in the summer months, would add 61.2 percent to the annual fuel and electricity bill.

(5) By turning heat on at 7:00 a.m. and off at 3:00 p.m. actual fuel consumption could be reduced by 13.8 percent annually.

Another study, this one conducted by the New York State Education Department, serves as a reminder that a school district's energy policy has an impact beyond the mere consumption of energy by the schools. Energy saved by closing schools may be consumed in the students' homes.

> Closing of school buildings during cold winter months may be counter-productive to total saving of energy. Energy needed for heat, light, and other school operations was found to be somewhat less when schools were closed. Energy consumption, as measured in the homes of children, was somewhat more when schools were closed. Thus it would seem that closing schools causes an increase in the use of fuels and electricity in the homes.

Administrators must consider factors such as climate, physical characteristics, and use of the building when determining scheduling changes. Since it is necessary to keep the building temperature at around 50° F to prevent freezing and structural damage, the amount of savings due to minor scheduling changes will not be significant in comparison to savings derived from retrofitting and other operations changes.

CONSTRUCTION OF NEW FACILITIES

The rate of new school construction in the 1980s will be less than that during the 1960s and early 1970s. Nevertheless, numerous buildings will be constructed, and energy considerations will become a major design consideration. The New Hampshire Board of Education reflected this attitude when it unanimously adopted the following policy: "It is to be expected, before approval of any submitted building plans for any purpose that involves school construction, that the very latest technology available will be utilized in energy conservation."

Architects and engineers are paying more attention to the building shell, insulation requirements, site orientation, amount of glass, multiple uses, equipment, and fuel energy considerations. Typically, energy considerations cause the initial costs of construction to be higher, but lower life-of-the-building costs can be expected. The

Northern California Chapter, American Institute of Architects, estimates that a 50 to 80 percent reduction in energy consumption is possible for new construction.

School districts should calculate the life-cycle cost of a building prior to approval of plans. Factors such as operating and maintenance costs become important considerations. During the life of a school facility, operating and maintenance costs (including energy costs) are three to four times the initial cost of the building. Data needed to conduct a life-cycle cost analysis are

(1) annual fixed charges, based on a capital recovery period of perhaps 20 years and including the interest charges;

(2) annual energy and fuel charges based on different energy sources under consideration and the fuel rate of different equipment;

(3) annual maintenance costs; and

(4) annual replacement cost of equipment.

The architect and engineer selected can assist with calculations and also provide information on the latest alternative technologies. For example, solar energy for heating is becoming more attractive and is feasible for school buildings in many parts of the nation. The National Science Foundation funded the design, construction, and evaluation of several school solar heating units. The results of one experiment at the Grover Cleveland School, Boston, Massachusetts, are as follows:

(1) Solar heating is effective and feasible in the northeastern United States.

(2) Over a full season the solar system is expected to provide more than 2/3 of the heating requirements of the middle third of the school (the portion served by the solar heating system).

(3) Institutional personnel (schools, governments, utilities, etc.) are highly interested in solar energy applications. They took the initiative to understand the system and actively participated in helping others to understand its operation and benefits.

(4) The technically aware public shows considerable interest in solar energy applications as evidenced by the number and types of visitors to the school.

(5) The solar system was compatible with local residences and businesses. No objections to shadowing, aesthetics, or even the inconveniences of the construction were evident.

(6) The construction workers were skeptical initially but became quite proud of working on the project when it became apparent that the solar heating worked.

(7) Even large, roof-mounted planar arrays are not particularly noticeable from a distance of a few city blocks.

(8) It is possible to utilize a solar array as a fascia to enhance a building's roof line.

(9) Resistance to vandalism is a major design consideration. Lexan window solar collectors withstood frequent impacts from thrown rocks and baseballs. There has been no damage to date and, for comparison, the school averages one broken window per week.

(10) Electronic integrators should be utilized for important data which varies randomly; i.e., solar flux.

A multitude of factors should be considered in planning the construction of an appropriate school facility. A helpful list (below) has been compiled by the New Hampshire State Department of Education in its Manual for Planning and Construction of School Buildings.

1. Do not exchange short-term minimal savings for long-term maximum gains.

2. Orient the building to take advantage of the natural energy-saving features of the site--use trees and other buildings as windbreaks from prevailing winds and storms. Place parking area so that it does not expose building to winter winds nor heat up summer cooling breezes.

3. Shape the building for optimum energy use. (Cubic shape maximizes volume while minimizing surface area.)

4. Design the facility on the edge of comfort; use humidity controls and good vapor barriers.

5. Consider burying part of the building to reduce heat losses and air infiltration.

6. Design the building for minimum acceptable exposed wall and roof areas.

7. Use sun to heat the building with south-facing windows, and provide thermal curtains or shades; during nighttime, use wind and nighttime ventilation to cool.

8. Supervision during building construction is essential to assure best use of building materials. Ensure vapor barriers and insulation are installed correctly.

9. Provide proper automatic controls--heat, ventilation, and for some lighting. Make use of natural ventilation when available; exhaust air to leeward direction.

10. Design efficient mechanical systems to cut down overheating and overlighting.

11. Use efficient lighting sources--concentrate light on tasks.

12. Room switching should be designed so unneeded rows of lights can be turned off (new fixtures provide means to illuminate only partial number of tubes).

13. Require day/night thermostat control for unoccupied temperature setback.

14. The building gross wall should have a heat loss factor not greater than .20

    a. The glass area of a wall should not exceed 20 percent of the total wall area.
    b. Windows generally should be double-glazed, thermopane, or combination with nighttime insulating curtain or panel.

    c. Locate windows advantageously.

    d. Storm doors or vestibules should be used.

15. The building roof, through proper insulation, should have a heat loss factor no greater than .05; for opaque walls the best factor should be no greater than .06; foundation walls below grade enclosing a heated space shall not be greater than 1.2. Floors to unheated spaces--heat loss factor should be .08 or less.

16. The heating system efficiency should drop no more than 10 percent at 1/2 load.

17. Heating duct air losses should be restricted to 3 percent of air volume.

18. Hot water and steam lines should be insulated.

Install low-volume boiler fixtures and shower heads.

19. Restrict ventilation to 3 cubic feet of air per person per minute when outside temperature is below 10° F.

20. Large building heating zones involving multiple rooms should be restricted to 3,000 square feet or less. Heating systems should be able to function without outside air being introduced.

21. Consider use of heat recovery systems that remove heat from the exhaust air to preheat incoming air.

TRANSPORTATION

Students must be transported to and from school (when they live outside the walking limits established by the district), on field trips, and for extracurricular activities. Data collected by the National Center for Educational Statistics show that in the U.S. nearly 268,000 school buses travel 2.6 billion miles annually to transport 21 million children attending grades K through 12. School buses use more than 350 million gallons of fuel annually to transport about 52 percent of all pupils in the country. This represents an energy consumption of 43,750 billion Btu's each year--about 7.5 million barrels of oil.

As with other components of an energy management program, a school district should adopt a transportation policy, establish objectives, and initiate a plan. A typical goal could be to transport the maximum number of pupils the shortest necessary distance in vehicles offering the greatest miles-per-gallon for the task.

National leadership to conserve energy in school bus transportation has come from such efforts as the Voluntary Truck and Bus Fuel Economy Program, developed jointly by the Department of Transportation, the Environmental Protection Agency, and the Department of Energy. This program has received the voluntary cooperation of motor carriers, vehicle manufacturers, component suppliers, and trade associations. The goals are twofold; i.e., to save fuel through the application of more fuel-efficient technology, and to encourage more efficient operating practices, including driver and mechanic training programs, better maintenance, and improved routing and scheduling.

One project of the Voluntary Truck and Bus Fuel Economy Program was the publication of ESTEEM--Encouraging School Transportation Effective Energy Management. Copies are

available from the Department of Energy, Voluntary Truck and Bus Fuel Economy Program, Washington, DC 20461. The handbook is designed for directors of pupil transportation, school administrators, and others involved in transportation management. It provides practical information about fuel conservation, recommendations for training mechanics and drivers, guidelines for purchasing equipment and fuel, and suggested administrative policies. Also available from this office is a newsletter, Fuel Economy News, that provides current information about transportation conservation efforts throughout the nation. Those interested in receiving copies may submit their name and address to the same office.

The ESTEEM handbook is designed to be used with the U.S. Department of Transportation's publication series, "Fuel Economy Through Teamwork." The series consists of five booklets addressing the subjects of:

1. Pupil Transportation and Energy Conservation
2. Purchasing for Fuel Economy
3. Driving for Fuel Economy
4. Operating for Fuel Economy
5. The Science of Saving Fuel

Copies of the series are available from the U.S. Department of Transportation, Voluntary Truck and Bus Fuel Economy Program, Washington, DC 20461.

The following checklist can be reviewed by school districts to assist in development of a transportation conservation program. It is excerpted from the document, The Energy Crisis in the Public Schools: Alternative Solutions, by Grossbach and Shaffer.

Vehicle Operation

1. Tune and maintain engines to peak performance. Correct faulty sparkplugs, points and carburetion.
2. Use modern analyzing equipment to ensure fuel and oil economy.
3. Keep gas tanks full to avoid excessive evaporation.
4. Ensure that bus tires are properly inflated.
5. Reduce speed limit to as low as practical.
6. Reduce weight by removing luggage racks, extra tire, chains, etc.

7. Drive slowly and carefully the first few miles until vehicle warms up.

8. Avoid the "red line" even in shifting gears.

9. Reduce warm-up time for buses to the very minimum. Have drivers turn off their engines during loading and unloading of children or at any time engine is idling more than 2 minutes.

10. Avoid full throttle operation.

11. Avoid courtesy stops.

12. Schedule bus routes to avoid driving up hills; stay on main roads only.

13. Plan stops on level instead of inclines.

14. Drive slowly back to the bus yard.

15. Use intercoms on buses to reduce stops for controlling discipline.

16. Install two-way radios to direct operation or redirection of buses to avoid unnecessary use.

17. Monitor use of vehicles. Install trip recorders to record driver and vehicle operation. Use this information to reduce use of gas and oil.

18. Plan routes to make only right turns to save on idling time.

19. Consolidate loads.

20. Centralize pickup and return points.

21. Use computers to analyze bus loads and schedule bus runs.

22. Eliminate buses that use excessive amounts of gasoline.

23. Eliminate operation of all buses not truly needed.

24. Use smaller vehicles for long-distance, light-load runs. Use the smallest bus possible.

25. Bus students only during inclement weather.

26. Eliminate transportation for summer school.

27. Encourage high school students to walk to school or to form car pools.

28. Lengthen distances between pickup points.

29. Have older students walk to central pickup points.

30. Cooperate with nonpublic schools to consolidate bus drivers.

31. Reduce field trips.

32. Use shuttle buses for students to and from athletic contests.

33. Minimize staggered school schedules.

34. Provide boarding for students who live in isolated areas a long distance from schools.

35. Use satellite bus parking.

36. If bus drivers have split shifts, determine if their last route ends near their home. If it does, have them take the bus home during the midday period. This will eliminate the extra driving that results from a driver bringing the bus back to the terminal, driving his car home, and driving his car back to the terminal.

37. When adding or replacing buses consider the smallest, most economical vehicle possible.

38. Change legislation which caused some buses to have capacity reduced.

39. Review and evaluate all security measures in the district. Make changes to take care of any increased problems resulting from the energy crisis.

Driver Inservice

1. Train new drivers on existing runs while bus is "deadheading."

2. Use simulators to reduce behind-the-wheel training in vehicles.

3. Increase frequency of driver inservice programs.

4. Retain experienced drivers as long as possible.

5. Train drivers to use pre-planned starts and stops for less gas consumption.

6. Hold joint workshops with maintenance and driver personnel to improve operation.

7. Use an incentive system for reducing vehicle fuel consumption.

Changes in School Organization

1. Reestablish the neighborhood school where students can walk.

2. Establish a four-day school week, thereby saving one day's driving of buses.

3. Consolidate beginning and ending times of all schools, including special education programs.

4. Relocate special education classes to neighborhood walking schools or centralized special classes in one location to avoid excessive transportation.

5. Review special programs to determine need for transportation. Determine if there are some special education students who could walk to their schools.

6. Enter into interdistrict attendance agreements with other districts to avoid excessive bus travel.

7. Change attendance boundaries to reduce transportation.

8. Increase walking distances.

9. Contract with parents to provide transportation.

10. Reduce school year to minimum number of days to save operation costs.

11. Eliminate transportation for summer school.

12. Share equipment and bus runs with neighboring districts.

Use of Vehicles for Trips Other Than to and from School

1. Combine field trip requests from more than one school.

2. Limit field trips to full bus loads only.

3. Establish minimum and maximum distances for field trips.

4. Combine school teams and schedules so several games can be played at the same time. Consolidate bus trips.

5. Have districts share buses when holding athletic events.

Alternate Forms of Transportation

1. Use parent transportation and give assistance to parent in obtaining necessary insurance.

2. Use charter and public transportation.

3. Students should be encouraged to form car pools. Provide them with protected parking.

4. Encourage use of bicycles. Provide adequate and protected bike racks.

5. Have parents provide transportation instead of using after-school activity buses.

Miscellaneous

1. Keep community informed of fuel-saving measures.

2. Use students and employees as resource persons for fuel-saving ideas.

3. Encourage students and employees to use car pools.

4. Develop an information exchange of ideas on fuel conservation between districts.

5. Offer incentives for schools to originate new ideas of fuel conservation.

6. Unload buses at the most sheltered entrance to buildings.

APPENDIX A: RESOURCES FOR ENERGY CONSERVATION MANAGEMENT FOR SCHOOL ADMINISTRATORS

The references in this section contain information useful to school administrators seeking to initiate or improve energy conservation management programs.

All references are identified by either an ED or EJ number which will make it possible to locate them. Documents listed with ED numbers are reported in the appropriate monthly issue of Resources in Education (RIE), a publication of the Educational Resources Information Center (ERIC) aimed toward early identification and acquisition of reports of interest to the educational community. RIE is made up of resumes and indexes. The resumes provide descriptions of each document and abstracts their content. The index section provides access to the resumes by subject, personal author, institution, and publication type. Many of the documents are available in microfiche or paper copy from ERIC Document Reproduction Service (EDRS), P. O. Box 190, Arlington, Virginia 22210, or may be located and reviewed in the growing number of ERIC microfiche collections distributed widely throughout the United States.

References with EJ numbers are journal articles. Abstracts and bibliographic information appears in Current Index to Journals in Education (CIJE), a monthly guide to current periodical literature in education. Approximately 775 educational and education-related journals are included. Copies of many of the articles reported in CIJE are available from University Microfilms International, 300 North Zeeb Road, Ann Arbor, Michigan 48106.

"A Decade's Difference--Expanded School, Same Energy Use," American School and University; V 53 N 1 (September 1980), pp. 38-40. EJ 232 055

Anderson, Bill. "39 Ways to Prevent Gasoline Costs from Burning Your Budget," American School Board Journal; V 166 N 11 (November 1979), pp. 33-35. EJ 210 936

Anderson, Calvin, and Bottinelli, Charles A. "Managing Your School's Energy Dollars: Keeping Your Schoolhouse Out of the Red," US Office of Education, Energy and Education Action Center, Washington, D.C. (1980). ED 193 071

Anderson, Calvin E. "The Impact of the Energy Crisis on School Finance," Phi Delta Kappan, V 57 N 3 (November 1975), pp. 193-196. EJ 125 815

Alberta Department of Education. "An Energy Management Programme for Grande Prarie Public School District. Energy Conservation: Energy Management," Calgary University, Alberta. (October 1979). ED 182 866

American Association of School Administrators. "AASA Energy Use Study," Washington, D.C. (August 1979). ED 190 341

American Association of School Administrators. "Public Schools Energy Conservation Measures: Management Summaries," Washington, D.C. (1978). ED 164 339

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 2: Central Elementary School, Glen Rock, New Jersey," Arlington, VA (January 1977). ED 194 359

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 4: Hindman Elementary School, Hindman, Kentucky," Arlington, VA. (January 1977). ED 194 360

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 5: Fairmoor Elementary School, Columbus, Ohio," Arlington, VA. (January 1977). ED 194 361

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 6: P. F. Brown Elementary School, Lubbock, Texas," Arlington, VA. (January 1977). ED 194 362

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 8: Garfield Elementary School, Sioux Falls, South Dakota," Arlington, VA. (January 1977). ED 194 363

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 9: Plover Whiting Elementary School, Stevens Point, Wisconsin." Arlington, VA. (January 1977). ED 194 364

American Association of School Administrators. "Public Schools Energy Conservation Measures, Report Number 10: Washington Elementary School, Kennewick, Washington," Arlington, VA. (January 1977). ED 194 369

"An Energy Source Directory," Library Journal; V 103 N 1 (January 1978), pp. 26-70. EJ 173 990

Arens, John G., and Jones, S. Harold. "How to Protect Yourself from Unqualified Contractors," American School and University; V 49 N 9 (July 1977), pp. 34-35. EJ 162 207

Askin, Ralph J. And Others. "California School Energy Concepts, 1978," California State Department of Education, Sacramento, CA (1978). ED 165 341

Association of Energy Engineers. "Energy Auditing," Atlanta, GA. (1980). ED 193 027

Association of Physical Plant Administrators of Universities and Colleges. "Application of Computer Assisted Energy Analysis Seminar (Pittsburgh, Pennsylvania, April 12-14, 1977)," Washington, D.C. (April 1977). ED 176 367

Association of School Business Officials. "Field-Proven Programs to Conserve Energy in Schools," Chicago, IL. (1980). ED 188 349

"Atlanta Says Yes to Solar Power," American School and University; V 52 N 9 (May 1980), pp. 48-50. EJ 225 454

Baker, William P. "This School System Cut Its Electric Bill by $230,754," American School Board Journal; V 167 N 1 (January 1980), pp. 45-46. EJ 212 400

Bazjanac, Vladimir. "Architectural Energy Analysis," Progressive Architecture; V 61 N 4 (April 1980), pp. 98-101. EJ 221 506

Berman, Richard M., and Hunt, Irmgard. "Energy Directory and Bibliography," Consumer Action Now's Council, New York, NY; New York State Alliance to Save Energy, Inc., New York (1977). ED 159 052

Birch, Anthony D. "Energy Management for an All-Electric Campus," American School and University; V 51 N 1 (September 1978), pp. 28-31. EJ 186 724

Blundell, W. Irvin. "Notions about Energy Management and Conservation," School Business Affairs; V 46 N 1 (January 1980), pp. 16-17,25. EJ 214 273

BRI Systems, Inc. "ESTEEM--Encouraging School Transportation Effective Energy Management - Fuel Economy Management Handbook for Directors of Pupil Transportation, School District Administrators, Transportation Department Management," Phoenix, AZ. (October 1977). ED 162 907

BRI Systems, Inc. "Fuel Economy Through Teamwork, Energy Savings in School Transportation Publication Series. 1. Pupil Transportation and Energy Conservation. 2. Purchasing for Fuel Economy. 3. Driving for Fuel Economy. 4. Operating for Fuel Economy. 5. The Science of Saving Fuel," Phoenix, AZ. (October 1977). ED 165 318

British Columbia Department of Education. "Energy Conservation for Schools, 1978 Edition, Report Number 00654-78-09," Victoria. (1978). ED 166 047

Brubaker, C. William. "Energy Conservation Through Rational Architecture and Planning," CEFP Journal; V 14 N 6 (November-December 1976), pp. 4-6,22. EJ 150 208

Brubaker, C. William. "New Directions in School Design," American School Board Journal; V 166 N 8 (August 1979), pp. 43-45. EJ 206 345

Canipe, Stephen L. Perspectives on School Energy Use. (1979). ED 182 804

Carnell, John E. "Seventeen Ways to Save Energy," Independent School; V 39 N 2 (December 1979), pp. 11-13. EJ 213 753

Centerline Co. "Solar Energy Directory: A Directory of Domestic and International Firms Involved in Solar Energy," Phoenix, AZ. (1978). ED 176 958

Collier, Herbert I. "LSU Slashes Energy Use," American School and University; V 51 N 2 (October 1978), pp. 34-36,38,40. EJ 188 707

Colorado State Department of Education. "District Level Plan for Conservation. An Outline for a District-Level Plan for Energy Conservation. Energy Conservation Materials Package Number 2," Denver, Interstate Energy Conservation Leadership. (1975). ED 122 364

Colorado State Department of Education. "Energy Conservation in School Facilities. Energy Conservation in Existing School Facilities: An Overview. Energy Conservation Materials Package Number 1," Denver, Interstate Energy Conservation Leadership. (1975). ED 122 363

Council of Educational Facility Planners. "Guide for Planning Educational Facilities. An Authoritative and Comprehensive Guide to the Planning of Educational Facilities from the Conception of Need through the Utilization of the Facility, Fifth Edition,: Columbus, OH. (1976). ED 125 071

Davis, Albert J., and Schubert, Robert P. Alternative Natural Energy Sources in Building Design. New York: Van Nostrand Reinhold Company. (1977). ED 162 847

Day, C. William. "Energy Conservation and Education Facilities," School Business Affairs; V 46 N 3 (March 1980), pp. 28,35. EJ 217 695

Dean, Andrea O. "Underground Architecture," AIA Journal; V 67 N 4 (April 1978), pp. 34-37. EJ 183 176

Dorgan, Charles E. "Energy Management and Energy Audits for Schools," CEFP Journal; V 16 N 4 (July-August 1978), pp. 4-5,19. EJ 186 717

Dorsey, R. T. "How to Get the Most from Your Lighting System," School Business Affairs; V 46 N 7 (June 1980), pp. 10-11,39. EJ 225 516

Educational Facilities Labs., Inc. "The Economy of Energy Conservation in Educational Facilities. A Report, New York. (1973). ED 082 321

Educational Facilities Labs., Inc. "The Economy of Energy Conservation in Educational Facilities. A Report." Revised Edition, New York. (June 1978). ED 167 392

Educational Facilities Labs., Inc. "School Calendars and Energy Use. Technical Report No. 3 of a Study of School Calendars. A Study of the Energy Implications of Nine School Calendars in 'Typical' New York State Elementary Schools," New York State Education Department, Albany Division of Research. (May 1978). ED 172 322

Electric Energy Association. "Cost and Energy Savings Opportunities with Heating, Air Conditioning and Lighting Systems in Schools," New York, NY. (1973). ED 083 674

"Energy Audit Workbook for Schools," Department of Energy, Washington, D.C. Office of State and Local Programs; Department of Energy, Washington, D.C. Office of State Grant Programs. (September 1978). ED 164 284

"Energy Conservation Techniques for Water Cooling Systems," School Business Affairs; V 46 N 7 (June 1980) pp. 25,39. EJ 225 521

"Energy Crisis: What Schools Are Doing About It," American School and University; V 46 N 6 (February 197-), pp. 53-57. EJ 092 648

"Energy: Design, Retrofit," Nation's Schools and Colleges; V 1 N 2 (October 1974), pp. 48-49. EJ 105 880

Energy Education Programs. "Total School Energy Management Program," Woodstock, IL. (March 1980). ED 187 019

"Energy Efficiency in School Renovation--Hand Middle School Shows How," CEFP Journal; V 17 N 4 (July-August 1979), pp. 11-14. EJ 209 475

"Energy Extension Service: A New National Resource," VocEd; V 54 N 1 (January 1979), pp. 54-55. EJ 199 172

"Energy Extra: Energy Savings vs. Comfort--And The Effect of Humidity," CEFP Journal; V 17 N 3 (May-June 1979), pp. 12-13. EJ 203 119

Estes, R. C. "Another Challenge in Conserving Electrical Energy--KVA," CEFP Journal; V 17 N 6 (November-December 1979), pp. 12-14. EJ 214 285

Estes, R. C. "Back to the Basics: Cooling with Ice," American School and University; V 52 N 2 (October 1979), pp. 54-55. EJ 209 417

Estes, R. C. "Designing for Energy Conservation," CEFP Journal; V 17 N 1 (January-February 1979), pp. 13-16. EJ 196 155

Filler, Martin. "Light Motives," Progressive Architecture; V 60 N 4 (April 1979), pp. 92-97. EJ 197 999

Fredrickson, John H. The Principal and Energy Conservation. (August 1977). ED 141 955

Fredrickson, John H. What Are Schools Doing to Save Energy? (1980). ED 188 346

Fuller, Robert H. "Acquiring Professional Services for Energy Management," CEFP Journal; V 16 N 4 (July-August 1978), pp. 15-16. EJ 186 720

General Electric Co. Solar Heating Experiment at the Grover Cleveland School, Final Report. Boston, MA (1974).

Gonder, Peggy Odell. "How Schools Can Save $$. Problems and Solutions. AASA Critical Issues Report," American Association of School Administrators, Arlington, VA; Education News Service, Sacramento, CA. (1980). ED 182 869

Grossbach, Wilmar, and Shaffer, William. "The Energy Crisis in the Public Schools; Alternative Solutions," Ventura County Superintendent of Schools, CA. (1974). ED 100 069

"Haverford: A Lesson in Energy Conservation," American School and University; V 52 N 4 (December 1979), pp. 28-29. EJ 212 386

"How Schools Are Saving Energy. Energy Checklist," School Business Affairs; V 42 N 2 (February 1976), pp. 35-36. EJ 134 430

"How Schools Can Plug the Energy Drain," Nation's Schools; V 92 N 4 (October 1973), pp. 10-11. EJ 084 486

"In Perspective: Three Underground Schools," Progressive Architecture; V 56 N 10 (October 1975), p. 30. EJ 124 206

Jones, Robert M., and Steinbrink, John E. "Developing Energy Conservation Programs," NASSP Bulletin; V 64 N 435 (April 1980), pp. 76-82. EJ 219 604

Jones, Thomas H., and Alubicki, Joseph. "A Federal Program for Public School Energy Conservation," Phi Delta Kappan; V 61 N 1 (September 1979), p. 25. EJ 206 299

Jones, Thomas H., and Alubicki, Joseph. "A Federal Program for Public School Energy Conservation," Planning and Changing; V 10 N 4 (Winter 1979), pp. 214-219. EJ 223 618

Kansas State Board of Regents. "Energy--1977," Topeka. (August 1977). ED 164 317

Kohler, Lewis T. "Conservation Report Card," American School and University; V 52 N 11 (July 1980), pp. 26-27. EJ 227 862

Kowle, Carol P. "New and Retrofitted Facilities for Energy Conservation. Information Series No. 152," Ohio State University, Columbus. National Center for Research in Vocational Education. (1979). ED 173 542

Kruza, Barbara. "How to Set Up an Energy Management Program," American School and University; V 52 N 3 (November 1979), pp. 58, 61-62,65-67. EJ 211 041

Liepins, G. E. And Others. "Buildings Energy Use Data Book, Edition 1," Oak Ridge National Lab., TN. (April 1978). ED 159 044

Lipp, Louie. "Save Energy in Your School Kitchen," American School and University; V 50 N 11 (July 1978), pp. 20-21. EJ 188 672

Massachusetts State Department of Education. "Focus On: Energy Conservation Practices in Schools," Boston, MA. (1980). ED 184 251

Massachusetts University. "Training Manual for the Energy Conservation Analysis Project," Amherst. Cooperative Extension Service. (1978). ED 162 891

"Meet the Load: Mechanical Matches," Progressive Architecture; V 60 N 4 (April 1979), pp. 88-91. EJ 197 998

Merrill, Glen L. "Solar Heating Proof-of-Concept Experiment for a Public School Building." Honeywell, Inc., Minneapolis, MN, Systems and Research Center. (1975). ED 136 443

"Metal Building Insulation System Provides Energy Savings and Noise Control," School Business Affairs; V 45 N 10 (October 1979), pp. 34-35. EJ 209 407

Miller, Betty. "Energy Information Online," Online; V 2 N 1 (January 1978), pp. 27-30. EJ 179 523

Miller, Harry, Comp., and Rowe, Peter, Comp. "Energy Management: A Program of Energy Conservation for the Community College Facility." California University, Berkeley. Lawrence Berkeley Lab. (1978). ED 167 405

Miller, Stanton S. "Boiler Operator Training," Environmental Science and Technology; V 12 N 10 (October 1978), p. 1121. EJ 193 040

Morgan, William. "Up to Earth," Progressive Architecture; V 60 N 4 (April 1979), pp. 84-87. EJ 197 997

"National Lighting Bureau Reports Dramatic Energy Savings Possible Through Minor Lighting Modifications," College Store Journal; V 46 N 5 (August-September 1979), pp. 112-114. EJ 211 261

Neal-Schuman Publishers, Comp. "An Energy Source Directory," School Library Journal; V 24 N 5 (January 1978), pp. 27-64. EJ 190 837

Neill, Shirley Boes. "School Energy Crisis: Problems and Solutions. AASA Critical Issues Report," Education News Service, Sacramento, CA. (1977). ED 170 110

New England Innovation Group. "Energy Conservation Measures for the Charles E. Shea Senior High School, Pawtucket, Rhode Island. Public Service Report," Providence, RI (July 1979). ED 194 340

New Hampshire State Department of Education. "Manual for Planning and Construction of School Buildings," Concord, NH. (1975). ED 149 487

New Jersey State Department of Education. "Code for School Planning and Construction," Trenton, NJ. Bureau of Facility Planning. (July 1979). ED 194 323

New York State Education Department. A Study of School Calendars," Albany. Division of Research. (December 1978). ED 170 891

New York State Education Department. "Energy Consumption in Schools and Homes. Technical Report No. 2 of a Study of School Calendars," Albany. Division of Research. (November 1978). ED 170 890

New York State Education Department. "Energy Savings Practices in Schools. Technical Report No. 4 of a Study of School Calendars," Albany. Division of Research. (November 1978). ED 172 323

New York State Education Department. "Energy Sources. Costs and Availability. Technical Report No. 1 of a Study of School Calendars," Albany. Division of Research. (November 1978). ED 172 321

Ober, A. Keith. "Conservation Yields a Net Profit," American School and University; V 52 N 4 (December 1979), pp. 38,40-41. EJ 212 388

Okalhoma State Department of Education. "Guide to Energy Management in Schools," Oklahoma City, OK. (1979). ED 182 862

Olsen, Wally. "Small School Creates Large Energy Savings," Thrust for Educational Leadership; V 8 N 2 (November 1978), pp. 21-22. EJ 200 709

"Ontario ASBO Energy Conservation Survey Results," School Business Affairs; V 46 N 5 (April 1980), pp. 30-31. EJ 221 486

Ontario Department of Education. "Energy Conservation for Schools," Toronto. (1975). ED 120 967

Oregon University. "Energy Conservation. The Best of ERIC, Number 19," Eugene. ERIC Clearinghouse on Educational Management. (August 1976). ED 125 099

Palmer, H. Stanley And Others. "Energy Management Bulletin: Microprocessors for Physical Plant Control Systems," CEFP Journal; V 17 N 5 (September-October 1979), pp. 12-13. EJ 215 975

Pennsylvania State Department of Education. "Energy Conservation Guidelines for Pennsylvania Schools," Harrisburg, PA. (1976). ED 132 707

Peterson, Irving, M. (Ed.), and Colavita, Leon J. (Ed.). "Energy Conservation Guidelines--1: District Level Plan for Conservation," New Jersey State Dept. of Education, Trenton. Bureau of Facility Planning. (1980). ED 194 355

Peterson, Irving M. (Ed.), and Gates, Richard M. (Ed.). "Energy Conservation Guidelines--2: Energy Conservation in School Facilities," New Jersey State Dept. of Education, Trenton. Bureau of Facility Planning. (1980). ED 194 356

Pierce, Roger A. "The Energy Lab Campus," American School and University; V 50 N 7 (March 1978), pp. 58,60,62,64. EJ 181 455

Piper, James E. "The Energy Audit: What It Can Do for You," American School and University; V 50 N 7 (March 1978), pp. 58,60,62,64. EJ 181 455

Polansky, Richard A. "Energy Crunch--No Time for Panic!" School Business Affairs; V 45 N 7 (July 1979), pp. 16-19. EJ 206 260

Porter, Kal. "New Facility Challenges = New Creative Solutions," CEFP Journal; V 17 N 4 (July-August 1979), pp. 15,17-18,21. EJ 206 476

Pritchard, Robert T. "The Energy Future--A Critical Management Challenge for School Business Administrators," School Business Affairs; V 45 N 7 (July 1979), pp. 16-19. EJ 209 402

Rakestraw, William E. "School Building Design: The Building as an Instructional Tool," CEFP Journal; V 17 N 6 (November-December 1979), p. 7. EJ 214 282

"Reduce the Load: The Building as a Heat Exchanger," Progressive Architecture; V 60 N 4 (April 1979), pp. 80-83. EJ 197 996

"Relighting Outdoor Recreation Facilities Reduces Energy and Maintenance Costs," School Business Affairs; V 40 N 10 (October 1979), pp. 33-34. EJ 209 405

"Renovation for Appearance Helps Save Energy," American School and University; V 52 N 10 (June 1980), p. 64. EJ 227 776

Rinehart, Milton, Comp. And Others. "Energy Education: A Bibliography of Abstracts from 'Resources in Education (RIE)' from 1966-1978." Ohio State University, Columbus, Ohio. Information Reference Center for Science, Mathematics, and Environmental Education. (1979). ED 166 067

Rinehart, Milton, Comp. And Others. "Energy Education: A Bibliography of Citations from 'Current Index to Journals in Education (CIJE)' from 1966-1978." Ohio State University, Columbus, Ohio. Information Reference Center for Science, Mathematics, and Environmental Education. (1979). ED 168 874

Rittlemann, Richard. "Design New Buildings to Save Energy--and Money," American School and University. (January 1974), p. 25. EJ 089 411

Robbins, J. A., and Turner, W. C. "No Computer? Try Wedging Bus Routes," Nation's Schools and Colleges; V 2 N 5 (May 1975), pp. 44-45. EJ 117 570

Robison, Rita. "Is There Coal in Your Future?" American School and University; V 53 N 1 (September 1980), pp. 52-57. EJ 232 056

Robison, Rita. "Passive Solar Is Common Sense," American School and University; V 52 N 4 (December 1979), p. 10. EJ 212 384

Robison, Rita. "Solar Energy Now?" American School and University; V 52 N 9 (May 1980), pp. 42-43. EJ 225 452

Ruud, Alan. "What to Look For In Classroom Lighting," American School and University; V 51 N 1 (September 1978), pp. 45-48. EJ 186 728

"Save Energy and Money for Schools with Heat Pumps," Executive Educator; V 2 N 4 (April 1980), p. 4. EJ 223 529

Schofield, Dee. "Community Schools. NAESP School Leadership Digest Series, Number Four. ERIC/CEM Research Analysis Series, Number Six." National Association of Elementary School Principals, Washington, D.C. (1974). ED 094 447

"School Bus Operators Told of Better Ways to Conserve Fuel," School Business Affairs; V 46 N 8 (July 1980), pp. 10-11. EJ 227 869

Schrader, Charles F. "You and Your Architect and Energy Conservation Savings for Educational Facilities. A Report." American Institute of Architects, Northern California Chapter. (April 1976). ED 120 904

Smith, Nancy R. "A Total Approach to Energy Conservation," School Business Affairs; V 46 N 5 (April 1980), p. 32. EJ 221 487

Smull, Neil A., and Armstrong, Gerald L. "Combined Active and Passive Solar Space Heating and Solar Hot Water Systems for an Elementary School in Boise, Idaho," CEFP Journal; V 17 N 2 (March-April 1979), pp. 16-17,27. EJ 199 488

Snee, Nancy. "Energy Conservation--Can Teachers Teach by Example?" Journal of the International Association of Pupil Personnel Workers; V 23 N 1 (January 1979), pp. 82-84. EJ 197 537

"Solar Schools: Rock LeFleche Development Center, Troy Elementary Schools," School Business Affairs; V 46 N 6 (June 1979), pp. 14-15. EJ 204 769

Stein, Richard G. And Others. "Low Energy Utilization School Energy Conservation Operation Manual. Phase 2: Report." New York City Board of Education, NY. (March 1977). ED 154 507

Stenzler, Yale. "Energy Conservation: How to Get Organized," American School and University; V 51 N 6 (March 1979), pp. 66-67. EJ 197 976

Stephan, Edward And Others. "Energy and Rural Schooling." Bureau of Elementary and Secondary Education, Washington, D.C. (May 1979). ED 172 972

Stephan, Edward. "Public Schools Energy Conservation Service," American School and University; V 48 N 5 (January 1976) pp. 43-44. EJ 129 396

Stephens, Suzanne. "Cool School," Progressive Architecture; V 61 N 4 (April 1980) pp. 166-169. EJ 221 519

Sullivan, Dallas. "Preliminary Energy Audits for Existing Buildings," CEFP Journal; V 16 N 4 (July-August 1978), pp. 10-13. EJ 186 719

"Sun Heats, Cools Columbus Tech," American School and University; V 52 N 9 (May 1980), pp. 44,46. EJ 225 453

Tenneco, Inc. "Something Special from SEED: Energy Efficiency for Educators and Students. SEED: Schoolhouse Energy Efficiency Demonstration," Houston, TX. (October 1979). ED 182 807

Tenneco, Inc. "The Fourth R: Resourcefulness in School Energy Conservation. SEED: Schoolhouse Energy Efficiency Demonstration," Houston, TX. (October 1979). ED 182 806

"Test Program Seeks to Lower School Heating Costs," School Business Affairs; V 46 N 1 (January 1980), pp. 14-15. EJ 214 272

Tetzloff, Richard D. Conducting Energy Audits of Your Schools, or "The Last One Out of Town, Please Turn Out the Lights." (April 1980). ED 188 285

Tickton, Sidney G. And Others. "The Energy Conservation Idea Handbook. A Compendium of Imaginative and Innovative Examples of Ideas and Practices at Colleges and Universities Today." Academy for Educational Development, Inc., Washington, D.C. (September 1980). ED 193 086

Tiedeman, Thomas V. "An Energy Conservation Retrofit Process for Existing Public and Institutional Facilities." Public Technology, Inc., Washington, D.C. (1977). ED 161 763

Tilton, Brian. "Make Time Clocks Work for You," American School and University; V 52 N 3 (November 1979), p. 10. EJ 211 030

"Using Hillsides Helps Conserve Energy," American School and University; V 51 N 10 (July 1979), pp. 34s-35s. EJ 204 764

Vanderweil, Gary. "Savings Begin with an Energy Audit," Consulting Engineer; V 47 N 5 (November 1976), pp. 88-91. EJ 148 079

Webb, L. Dean, and Ashby, Glenn H. "Changing the School Calendar to Effect Energy Savings," School Business Affairs; V 46 N 1 (January 1980), pp. 11-13. EJ 214 271

Weinerman, Robert A. "Energy Conservation--A Big Payoff," Independent School; V 39 N 2 (December 1979), pp. 13-14. EJ 213 754

Williamson, Tom. "Implementing Audit Recommendations," CEFP Journal; V 16 N 4 (July-August 1978), pp. 18-19. EJ 186 721

Wisconsin Association of School Boards. "Energy Management. A Guide for School Districts," Winneconne. (1978). ED 191 186

Woodbury, Kenneth B., Jr. "A Practical Guide to Energy Conservation," American School and University; V 52 N 7 (March 1980), pp. 68-70. EJ 221 462

Young, Stuart, and Richmond, Jim. "Energy Conservation: What Schools Can Do Now. OSCC Bulletin Vol. 23, No. 7." Oregon School Study Council, Eugene, OR. (March 1980). ED 182 835

APPENDIX B: GOVERNMENTAL AND PRIVATE SOURCES OF ASSISTANCE ON ENERGY MANAGEMENT

GOVERNMENTAL AGENCIES

Community Services Administration
1200 Nineteenth Street NW
Washington, DC 20506
202/254-5590

Department of Commerce
14th St. (Between Consititution Ave. and "E" St., NW)
Washington, DC 20230
202/377-2000

Department of Defense
The Pentagon
Washington, DC 20301
202/545-6700

Department of Education
400 Maryland Avenue SW
Washington, DC 20202
202/245-8795

Department of Energy
Washington, DC 20545
202/252-5000

Department of Housing and Urban Development
451 Seventh Street SW
Washington, DC 20410
202/755-5111

Department of Transportation
400 Seventh Street SW
Washington, DC 20590
202/426-4000

Environmental Protection Agency
401 "M" Street SW
Washington, DC 20460
202/755-2673

Government Printing Office
North Capitol and "H" Streets NW
Washington, DC 20401
202/275-2051

Library of Congress
10 First Street SE
Washington, DC 20540
202/426-5000

National Academy of Science-
National Academy of Engineering
2101 Constitution Avenue NW
Washington, DC 20418

National Science Foundation
1800 "G" Street NW
Washington, DC 20550

National Technical Information Service
(Department of Commerce)
5285 Port Royal Road
Springfield, VA 22161
703/537-4660

Tennessee Valley Authority
400 Commerce Avenue
Knoxville, TN 37902

PRIVATE ORGANIZATIONS

Air Conditioning and Refrigeration Institute
1815 North Fort Myer Drive
Arlington, VA 22209

American Association of School Administrators
1801 North Moore Street
Arlington, VA 22209

American Home Lighting Institute
230 North Michigan Avenue
Chicago, IL 60601

American Institute of Architects
1735 New York Avenue NW
Washington, DC 20006

American Institute of Plant Engineers (AIPE)
1021 Delta Avenue
Cincinnati, OH 45203

American Society of Heating, Refrigerating and
Air-Conditioning Engineers, Inc. (ASHRAE)
345 East 47th Street
New York, NY 10017

The American Society of Mechanical Engineers (ASME)
345 East 47th Street
New York, NY 10017

Association of Home Appliance Manufacturers
20 North Wacker Drive
Chicago, IL 60606

Association of Physical Plant Administrators of Universities and Colleges
11 Dupont Circle, Suite 250
Washington, DC 20036

Building Officials and Code Administrators International, Inc. (BOCA International)
1313 East 60th Street
Chicago, IL 60637

The Conservation Foundation
1717 Massachusetts Avenue NW
Washington, DC 20036

Council of Educational Facility Planners, International
29 West Woodruff Avenue
Columbus, OH 43210

Edison Electric Institute
90 Park Avenue
New York, NY 10016

Educational Facilities Laboratories
850 Third Avenue
New York, NY 10022

Energy Conservation Council (ECC)
P. O. Box 7800
Atlanta, GA 30309

Illuminating Engineering Society of North America (IES)
345 East 47th Street
New York, NY 10017

Motor Vehicle Manufacturers Association
1909 "K" Street NW
Washington, DC 20006

National Conference of States on Building Codes and Standards, Inc.
1970 Chain Bridge Road
McLean, VA 22101

National Electrical Manufacturers Association (NEMA)
2101 "L" Street NW
Washington, DC 20037

National Energy Foundation
521 Fifth Avenue
New York, NY 10017

National Environmental Systems
Contractors Association (NESCA)
1501 Wilson Boulevard
Arlington, VA 22209

National Insulation Contractors
Association (NICA)
1120 19th Street NW, Suite 405
Washington, DC 20036

National Mineral Wool Insulation
Association, Inc. (NMWIA)
362 Springfield Avenue
Summit, NJ 07901

National Science Teachers Association
1742 Connecticut Avenue NW
Washington, DC 20009

National Solar Heating and Cooling Information
Center
P. O. Box 1607
Rockville, MD 20850

Sheet Metal and Air Conditioning
Contractors' National Association
8224 Old Courthouse Road
Vienna, VA 22160

Solar Energy Industries Association
Suite 632, 1001 Connecticut Avenue NW
Washington, DC 20036

Solar Energy Institute of America, Inc.
1110 6th Street NW
Washington, DC 20001